

Christopher Howard House
Professor of Geosciences
The Pennsylvania State University

Professional Preparation

- 1999 Ph.D. in Geology, University of California, Los Angeles
“Carbon Isotopic Fractionation by Diverse Extant and Fossil Prokaryotes”
Graduate advisor – J. William Schopf, Ph.D.
- 1995 B.S. in Biochemistry & Cell Biology, University of California, San Diego
Undergraduate advisor – Stanley L. Miller, Ph.D.

Appointments

- 2012-present Professor of Geosciences, The Pennsylvania State University
2008-present Pennsylvania Space Grant Consortium, Director
2008-present Penn State Astrobiology Research Center, Director
2000-present Huck Institute for the Life Sciences faculty appointment, Penn State
2006-2012 Associate Professor of Geosciences, Penn State
2000-2006 Assistant Professor of Geosciences, Penn State
1998-1999 Research Assistant, IGPP Center for Astrobiology, UCLA
1997-1997 Visiting Researcher, Lehrstuhl für Mikrobiologie, Regensburg, Germany
1996-1998 Teaching/Research Assistant, ESS, UCLA
1993-1994 Summer Fellow, NSCORT in Exobiology

Honors and Awards

- 2016 Fellow of the Geological Society of America (GSA)
2016-present Co-chair of NAS Committee for Astrobiology and Planetary Sciences (CAPS)
2016-present Participating Scientist for the Mars Science Laboratory (MSL) Mission
2012-2016 Member of NASA Advisory Council, Planetary Sciences Subcommittee
2010 Selected for a organic geochemistry position for IODP Expedition 331
2008 Paper selected as an ACS Publications Most-Accessed Article
2006-2007 Ocean Drilling Program Distinguished Lecturer
2005-2008 Scientific Ocean Drilling Vessel (SODV) Program Advisory Committee Member
2003-2015 Subject Editor for *Geobiology*
2003 Selected by Penn State as one of two Packard Fellowship nominees
2002 ISI Essential Science Indicators Geosciences Hot New Paper for November
2002 Selected for a microbiology position of Leg 201 of the Ocean Drilling Program
2000 “The Science Paper of the Month in Astrobiology” at NASA Headquarters
2000 Poster Award at NASA’s First Semi-annual Astrobiology Science Conference
2000 Institute for Molecular Evolutionary Genetics Membership, Penn State
1999 Poster Award at ISSOL conference in La Jolla, CA
1996-1997 Graduate Fellow, UCLA Center for the study of Evolution and the Origin of Life
1994-1995 Adjunct Fellow, NSCORT in Exobiology
1994 UCSD Undergraduate Research Scholar Award

Research Interests

Biogeochemistry, Geobiology, Molecular Evolution, Origin of Life, and Planetary Science

Peer-reviewed Journal Publications

- Brandt, L.D., and House, C.H., 2016. Marine Subsurface Microbial Community Shifts Across a Hydrothermal Gradient in Okinawa Trough Sediments. *Archaea*.
- Smith, K.E., House, C.H., Dworkin, J.P., Callahan, M.P., 2016. Spontaneous oligomerization of nucleotide alternatives in aqueous solutions. *Origins of Life & Evolution of Biospheres*, 1-9.
- Peng, X., Guo, Z., House, C.H., Chen, S., Ta, K., 2016. SIMS and NanoSIMS analyses of well-preserved microfossils imply oxygen-producing photosynthesis in the Mesoproterozoic anoxic ocean. *Chemical Geology* 441, 24-34.
- House, C. H., 2015. A synthetic standard for the analysis of carbon isotopes of carbon in silicates, and the observation of a significant water-associated matrix effect. *Geochemical transactions*, 16, 1-8.
- House, C. H., Pellegrini, M., & Fitz-Gibbon, S. T., 2015. Genome-wide gene order distances support clustering the gram-positive bacteria. *Frontiers in Microbiology*, 5, 785.
- Todd, Z. R., & House, C. H., 2014. Vesicles Protect Activated Acetic Acid. *Astrobiology*, 14, 859-865.
- Smith, K. E., Callahan, M. P., Gerakines, P. A., Dworkin, J. P., and House, C. H., 2014. Investigation of pyridine carboxylic acids in CM2 carbonaceous chondrites: Potential precursor molecules for ancient coenzymes. *Geochimica et Cosmochimica Acta*, 136, 1-12.
- Worth, R. J., Sigurdsson, S., and House, C. H. 2013. Seeding Life on the Moons of the Outer Planets via Lithopanspermia. *Astrobiology*, 13, 1155-1165.
- Yanagawa, K., Nunoura, T., McAllister, S. M., Hirai, M., Breuker, A., Brandt, L., ... and Takai, K., 2013. The first microbiological contamination assessment by deep-sea drilling and coring by the D/V Chikyu at the Iheya North hydrothermal field in the Mid-Okinawa Trough (IODP Expedition 331). *Frontiers in microbiology*, 4.
- House, C. H., Oehler, D. Z., Sugitani, K., and Mimura, K., 2013. Carbon isotopic analyses of ca. 3.0 Ga microstructures imply planktonic autotrophs inhabited Earth's early oceans. *Geology*, 41(6), 651-654.
- Cameron, V., House, C. H., and Brantley, S. L., 2012. A First Analysis of Metallome Biosignatures of Hyperthermophilic Archaea. *Archaea*.
- Rhodes, M.E., Oren, A., and House, C.H., 2012. Dynamics and persistence of Dead Sea microbial populations as shown by high-throughput sequencing of rRNA. *Applied and Environmental Microbiology*, 78: 2489-2492.
- Martino, A.J., Rhodes, M.E., Biddle, J.F., Brandt, L.D., Tomosho, L.P., and House, C.H., 2012. Novel degenerate PCR method for whole genome amplification applied to Peru Margin (ODP Leg 201) subsurface samples. *Frontiers in Extreme Microbiology*. 3: Article 17.
- House, C.H., Beal, E.J., and Orphan, V.J., 2011. The Apparent Involvement of ANMEs in Mineral Dependent Methane Oxidation, as an Analog for Possible Martian Methanotrophy. *Life*. 1: 19-33.
- Rhodes, M.E., Spear, J.R., Oren, A. and House, C.H., 2011. Differences in lateral gene transfer in hypersaline versus thermal environments. *BMC Evolutionary Biology*, 11: 199doi:10.1186/1471-2148-11-199
- Callahan, M.P., Smith, K.E., Cleaves, H.J.,II, Ruzicka, J., Stern, J.C., Glavin, D.P., House, C.H., and Dworkin, J.P., 2011. Carbonaceous meteorites contain a wide range of extraterrestrial nucleobases. *Proceedings of the National Academy of Sciences*, 1106493108v1-13998.

- Beal, E., Claire, M.W., House, C.H., 2011. The anaerobic oxidation of methane at low sulfate concentrations and the redox state of Earth's atmosphere through time. *Geobiology*, 9, 131-139.
- Biddle, J.A., White, J.R., Teske, A.P., House, C.H., 2011. Metagenomics of the subsurface Brazos-Trinity Basin (IODP Site 1320): comparison with other sediment and pyrosequenced metagenomes. *The ISME Journal*, doi:10.1038/ismej.2010.199.
- Rhodes, M.E., Fitz-Gibbon, S.T., Oren, A., House, C.H., 2010. Amino Acid Signatures of Salinity on an Environmental Scale with a Focus on the Dead Sea. *Environmental Microbiology*, 12: 2613-2623.
- Beal, E.J., House, C.H., Orphan, V.J., 2009. Manganese- and Iron- Dependent Marine Methane Oxidation. *Science*, 325: 184 – 187.
- House, C.H., Orphan, V.O., Turk, K.A., Thomas, B., Pernthaler, A., Vrentas, J. M., Joye, S.B., 2009. Extensive carbon isotopic heterogeneity among methane seep microbiota. *Environmental Microbiology*, 11: 2207 – 2215.
- Cameron, V., Vance, D. Archer, C. House, C.H., 2009. Nickel Stable Isotopes: A Novel Isotope Biomarker. *Proceeding of the National Academy of Sciences*, 106: 10944-10948.
- Orphan, V.J., Turk, K.A., Green, A.M., House, C.H., 2009. Patterns of ¹⁵N assimilation and growth of methanotrophic ANME-2 archaea and sulfate-reducing bacteria within structured syntrophic consortia revealed by FISH-SIMS. *Environ. Microb.*, 11: 1777 -1791.
- Orphan, V.J., and House, C.H., 2009. Geobiological investigations using secondary ion mass spectrometry (SIMS): microanalytical analysis of extant and ancient microbial processes. *Geobiology*, 7: 360 – 372.
- House, C.H. 2009. The Tree of Life viewed through the contents of genomes. *Methods in Molecular Biology*, 532: 141-161.
- Moran, J.J., House, C.H., Vrentas, J.M., Freeman, K.H., 2008. Methyl Sulfide Production by a Novel Carbon Monoxide Metabolism in Methanosarcina acetivorans. *Applied and Environmental Microbiology*. 74: 540-542.
- Zerkle, A.L., C.K. Junium, D.E. Canfield, House, C.H., 2008. Production of ¹⁵N-depleted biomass during cyanobacterial N₂-fixation at high Fe concentrations, *J. Geophys. Res.*, 113: G03014.
- Biddle, J.F., Fitz-Gibbon, S.T., Schuster, S.C., Brenchley, J.E., House, C.H., 2008. Metagenomic signatures of the subseafloor biosphere. *PNAS* 105: 10583-10588.
- Moran, J.J., Beal, E.J., Vrentas, J.M., Orphan, V.J., Freeman, K.H., House, C.H., 2008. Methyl sulfides as intermediates in the anaerobic oxidation of methane. *Environmental Microbiology*. 10: 162.
- House, K.Z., House, C.H., Schrag, D.P., Aziz, M.J., 2007. Electrochemical Acceleration of Chemical Weathering as an Energetically Feasible Approach to Mitigating Anthropogenic Climate Change. *Environ. Sci. Technol.*, 41, 24: 8464 – 8470 (featured as a ACS most downloaded paper).
- Trueude, T., Orphan, V., Knittel, K., Gieseke, A., House, C.H., Boetius, A., 2007. Consumption of methane and CO₂ by methanotrophic microbial mats from gas seeps of the anoxic Black Sea. *Applied and Environmental Microbiology*.
- Moran, J.J., House, C.H., Thomas, B., Freeman, K.H., 2007. Products of trace methane oxidation during nonmethylophilic growth by Methanosarcina. *Journal of Geophysical Research*, 112: G02011.
- Hausrath, E.M., Liermann, L.J., House, C.H., Ferry, J.G., Brantley, S.L., 2007. The effect of methanogen growth on mineral substrates: will Ni markers of methanogen-based

- communities be detectable in the rock record? *Geobiology*, 5: 49-61.
- Biddle, J.F., Lipp, J.S., Lever, M., Lloyd, K., Sørensen, K., Anderson, R., Fredricks, H.F., Elvert, M., Kelly, T.J., Schrag, D.P., Sogin, M.L., Brenchley, J.E., Teske, A., House, C.H., Hinrichs, K., 2006. Novel heterotrophic Archaea dominate sedimentary subsurface ecosystems off Peru. *Proceedings of the National Academy of Sciences*, 103: 3846-3851.
- Ferry, J.G., and House, C.H., 2006. The Stepwise Evolution of Early Life Driven by Energy Conservation. *Molecular Biology and Evolution*, 23: 1286-1292.
- Zerkle, A.L., House, C.H., Cox, R.P., Canfield, D.E., 2006. Metal limitation of cyanobacterial N₂ fixation and implications for the Precambrian nitrogen cycle. *Geobiology*, 4: 285-297.
- Biddle, J.F., House, C.H., Brenchley, J.E., 2005. Microbial stratification in deeply buried marine sediment reflects changes in sulfate/methane geochemistry. *Geobiology*, 3: 287-295.
- Biddle, J.F., House, C.H., Brenchley, J.E., 2005. Enrichment cultivation of microorganisms from sediment from the slope of the Peru Trench (ODP Site 1230). *Proceedings of the Ocean Drilling Program, Scientific Results*, 201.
- Moran, J. J., House, C. H., Freeman, K. H., Ferry, J. G., 2005. Trace methane oxidation studied in several Euryarchaeota under diverse conditions. *Archaea*, 1: 293-301.
- Zerkle, A.L., House, C.H., Brantley, S., 2005 Genomic Study of Biogeochemical Signatures for Microbial Metabolisms through Time. *American Journal of Science*, 305: 467-502.
- D'Hondt, S., and 34 others., 2004. Distributions of Microbial Activities in Deep Subseafloor Sediments. *Science*, 306: 2216-2221.
- Orphan, V.J., Ussler III, W., Naehr, T., House, C.H., Hinrichs, K.U., Paull, C. K., 2004. Geological, Geochemical, and Microbiological Heterogeneity of the Seafloor Around Methane Vents in the Eel River Basin, offshore California. *Chem. Geology*, 205: 265-289.
- House, C.H., Cragg, B., Teske, A., and the Leg 201 Shipboard Scientific Party, 2003. Drilling Contamination Tests on ODP Leg 201 Using Chemical and Particulate Tracers. *Proceedings of the Ocean Drilling Program, Initial Reports*, 201: Ch. 2, 1-19.
- House, C.H., Schopf, J.W., Stetter, K.O., 2003. Carbon isotopic fractionation by Archeans and other thermophilic Prokaryotes. *Organic Geochemistry*, 34: 345-356.
- House, C.H., Runnegar, B., Fitz-Gibbon, S.T., 2003. Geobiological analysis using whole genome-based tree building applied to the Bacteria, Archaea, and Eukarya. *Geobiology*, 1: 15-26.
- House, C.H. and Fitz-Gibbon, S.T., 2002. Using homolog groups to create a whole-genomic tree of free-living organisms: an update. *Journal of Molecular Evolution*, 53: 539-547.
- Orphan, V.J., House, C.H., Hinrichs, K.U., McKeegan, K.D., DeLong, E.F., 2002. Multiple archaeal groups mediate methane oxidation in anoxic cold seep sediments. *Proceedings of the National Academy of Sciences*, 99: 7663-7668.
- Orphan, V.J., House, C.H., Hinrichs, K.U., McKeegan, K.D., DeLong, E.F., 2001. Coupled isotopic and phylogenetic characterization of single cells: direct evidence for a methane-consuming archaeal/bacterial consortium. *Science*, 293: 484-487.
- House, C. H., Schopf, J.W., McKeegan, K.D., Coath, C. D., Harrison, T. M., Stetter, K. O., 2000. Carbon isotopic composition of individual Precambrian microfossils. *Geology*, 28: 707-710.
- Fitz-Gibbon, S.T., House, C.H., 1999. Whole Genome-based Phylogenetic Analysis of Free-Living Microorganisms. *Nucleic Acids Research*, 27: 4218-4222
- House, C.H. and Miller, S.L., 1996, Hydrolysis of dihydrouridine and related compounds. *Biochemistry*, 35: 315-320.

Other Published Journal Articles and Reports

- House, C.H., 2015. Penciling in details of the Hadean, *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.1519765112
- Shipboard Scientific Party, 2011. Deep Hot Biosphere. *Proceedings of the Ocean Drilling Program, Expedition Report*, 331.
- Shipboard Scientific Party, 2003. Controls on Microbial Communities in Deeply Buried Sediments, Eastern Equatorial Pacific and Peru Margin. *Proceedings of the Ocean Drilling Program, Initial Reports*, 201: Ch. 1 & Ch. 5-12.
- House, C.H., 2007. Linking taxonomy with environmental geochemistry and why it matters to the field of geobiology. *Geobiology*, 5: 1-3.
- House, C.H., and Schuster, S.C., 2006. Box 1. IODP Microbiology Through Massively Parallel DNA Sequencing. *Oceanography*, 19: 68.
- House, C.H., 2003. To Build a Pre-RNA. *Astrobiology*, 3: 245-247.

Patents Filed

House, K.Z., House, C.H., Aziz, M. Carbon Dioxide Capture and Related Processes.

Graduate Students Advised

Karianne L. C. Smith (M.Ed., completed), Aubrey Zerkle (Ph.D., completed), Jennifer Biddle (Ph.D., co-advised, completed), Jim Moran (Ph.D., completed), Vyllinniskii Cameron (Ph.D., completed), Beth A. Bauman (M.S., completed), Burt Thomas (Ph.D., co-advised, completed), Emily J. Beal (Ph.D., completed), Moshe Rhodes (Ph.D., completed), Amanda Martino (Ph.D., completed), Karen Smith (Ph.D., completed), Peter Ilhardt (M.S., completed), Leah Brandt (Ph.D., completed), Regina Wilpiseski (Ph.D., current), Laura Rodriguez (Ph.D., current), Greg Wong (Ph.D., current)

Postdoctorial Students Advised

Jennifer Biddle, Ph.D., Lisa Steinberg, Ph.D., Rachel Wagner, Ph.D., and Jeff Havig, Ph.D.

Grants Received

- 2016-2020 \$379,700 (NASA), House as PI
Enhanced Evaluation of the Possible Habitability of Ancient Mars through Possible Earth Analogs
- 2016-2018 \$720,000 (NASA), House as PI
Pennsylvania Space Grant Consortium Augmentation
- 2015-2018 \$1,375,000 (NASA), House as PI
Pennsylvania Space Grant Consortium
- 2015-2017 \$265,993 (NASA), House as PI
Exploring the Fate of Heterocyclic Compounds in Complex Prebiotic Mixtures
- 2013-2014 \$50,000 (C-DEBI), mini-grant from NSF center
Investigating the active microbial community members as a function of temperature in a hydrothermal subsurface

2013-2015 \$436,634 (NASA), House as PI
STEM Academic Research Training engaging Underrepresented Pennsylvanians (START-UP)

2010-2014 \$15,000 (COL), House as PI
Exploring for life at great depth and examining patterns of microbial diversity in the Costa Rica Margin subsurface

2011-2013 \$249,560 (NASA), House as PI
Safety, Reliability, and Reproducibility of Microbial Systems for Space Colonization

2010-2013 \$17,908 (NAI DDF), House as PI
Pilot Citizen Science Study of Distributed Domestic Water Heater Microbiology Diversity

2010-2014 \$15,000 (COL), House as PI
Metagenomics of the Okinawa Back-arc Basin

2010-2014 \$15,000 (COL), House as PI
Exploring Anaerobic Oxidation of Methane in the Deep, Hot Biosphere

2010-2013 \$148,472 – PSU portion (DOE)
Characterizing the mechanisms and syntrophic interactions driving the anaerobic oxidation of methane: cell-specific analysis using stable isotope tracers, targeted proteomics and single-cell imaging of structured microbial consortia and their gene products

2010-2014 \$2,850,000 (NASA), House as PI
Pennsylvania Space Grant Consortium

2009-2014 \$8,728,908 (NASA), House as PI
Signatures of Life from Earth and Beyond

2009 \$70,000 (NASA), House as PI
Space Colonization Life-support based on Electrochemical and Microbial Processes

2008-2009 \$44,883 (NSF), House as PI
IODP Microbiology through Massively Parallel DNA Sequencing Supplement

2008-2010 \$1,575,000 (NASA), House as PI
Pennsylvania Space Grant Consortium

2007-2008 \$153,609 (NAI DDF), House as PI
Molecular Signatures of Life on the Edge

2006-2009 \$210,000 (NSF), House as PI
IODP Microbiology through Massively Parallel DNA Sequencing

2005-2007 \$250,000 (Moore Foundation), House as PI
Ion microprobe upgrade for marine microbiology applications: Improved spatial resolution of isotopic analysis and enhanced imaging capabilities

2003-2008 \$6,430,646 – House laboratory portion is ~\$250,000 (NASA)
Evolution of a Habitable Planet

2005-2007 \$16,000 (JOI), House as PI
Leg 308 Post-Cruise Science Proposal: Metagenomics of the Subsurface Biosphere

2005-2007 \$218,240 (NASA), House as PI
Mediation of Early Microbial Evolution and Ecology by Cyanide Inhibition?

- 2005-2006 \$0 (DOE JGI)
 Hypothermophilic Archaeal Species
- 2005 \$11,949 (NURP)
 Microscale molecular and isotopic investigations of carbon transfer and microbial trophic interactions in marine methane seeps
- 2005 \$3,000 (PSU), House as PI
 Summer Research: Pore water Geochemistry of in Eel River Basin
- 2005 \$6,000 (NSF), House as PI
 NSF REU Supplemental Request for: "Examination of diverse anaerobic methane oxidizing Archaea and associated syntrophic relationships using high resolution molecular and isotopic methods"
- 2004-2007 \$254,318 (NSF), PSU portion of two-laboratory collaborative grant
 Examination of diverse anaerobic methane oxidizing Archaea and associated syntrophic relationships using high resolution molecular and isotopic methods
- 2002-2005 \$5,000 (Ettinger Foundation), House as PI
 Geomicrobiological Studies
- 2000-2004 \$40,000 (NSF), House as PI
 International Studies in Microbial Biogeochemistry: An IGERT Funding Supplement
- 2002-2004 \$22,556 (JOI), House as PI
 Post-Cruise Science Proposal: Probing the Subsurface Biosphere
- 2000-2003 \$314,309 (NASA)
 Exploring New Frontiers of the Connections Between the Biological and the Environmental Evolution of the Early Earth
- 2001-2002 \$5,000 (Penn State), House as PI
 Carbon isotopic analysis of target ribosomal RNA
- 2000-2001 \$8,000 (Penn State), House as PI
 AMO: a test of the syntrophic growth hypothesis for reverse methanogenesis

Invited Lectures

- SAM Instrument Team Meeting, Caltech, Spring 2017, Title: Carbon isotopic fractionation during pyrolysis to methane.
- Research Unplugged, Fall 2016. Title: Red Rover: Exploring NASA's Robotic Mission on Mars
- Delaware Valley Amateur Astronomers, Fall 2016. Title: The Curiosity Rover at Gale Crater, insights from a New Member of the Mars Science Laboratory Mission
- MSL Science Team Meeting, Caltech, Spring 2016, Title: Enhanced Evaluation of the Possible Habitability of Ancient Mars through Possible Earth Analogs.
- Penn State Astronomy Department, Spring 2014. Title: Icy-World Ceres Explorer (ICE): A low-cost astrobiology mission to the icy planet that we can reach and explore!.
- Penn State Astronomy Department, Fall 2013. Title: Astrobiology right here on Earth: Direct isotopic analysis of modern and ancient microbial cells.
- Penn State Microbiology Symposium, Fall 2013. Title: Direct isotopic analysis of microbial cells.
- Penn State Public Talk, Fall 2012. Title Controlled Ecological Life Support Systems: A Key to Space Colonization.
- Penn State Plant Pathology and Environmental Microbiology Department, Spring 2012: Title: Direct isotopic analysis of environmental microbial cells.

Penn State Earth and Environmental Systems Institute, Fall 2011. Title: The Pennsylvania Space Grant Consortium and Penn State Astrobiology Research Centers.

Penn State Geosciences Club, Spring 2011. Title: Studying extreme environments in preparation for the search for microbial life beyond the Earth.

Hershey Medical Center, Fall 2010. Title: Coupling microscopy with isotopic analysis to study marine sediment microbiota.

Tokyo University, Spring 2010. Title: Various views on early life.

JAMSTEC (Yokohama, Japan), Spring 2010. Title: Astrobiology right here on Earth: Direct isotopic analysis of microbial cells from the subsurface biosphere.

JPGU (Toyko, Japan), Spring 2010. Title: Astrobiology right here on Earth: Direct isotopic analysis of microbial cells from the subsurface biosphere.

Yale University, Spring 2010. Title: Astrobiology right here on Earth: Direct isotopic analysis of microbial cells from the subsurface biosphere.

Rensselaer Polytechnic Institute. New York Center for Studies on the Origin of Life. Spring 2009. Title: Moving beyond sulfate-dependent methane oxidation in cold seeps. National Space Grant Conference (Portland, OR), Fall 2009. Title: Penn State Astrobiology Research Center (PSARC): Probing “Unusual” Microorganisms of the Earth.

Gordon Research Conference on Organic Geochemistry, Summer 2008. Title: “Methylogenesis” by Methanosarcina: a Possible Model for the Anaerobic Oxidation of Methane.

Penn State University, Fall 2008. Title: Linking taxonomy with Environmental Chemistry in Marine Sediments.

Central State University, Spring 2007. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of Eastern Kentucky, Spring 2007. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of Arkansas, Spring 2007. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of Texas, Arlington, Spring 2007. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

Penn State University, Spring 2007. Title: Methane munching microbes meandering on margins. La Salle University, Fall 2006. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of Idaho, Fall 2006. First title: Linking Taxonomy with Environmental Geochemistry: The Anaerobic Oxidation of Methane in Cold Seeps. Second title: Probing the Microbiology of Deeply Buried Marine Sediments

Caltech, Fall 2006. Title: Gene Sequences, Gene Content, and Gene Order: Trying to find a “Genomic” Record for Geobiology.

University of California, Riverside. Fall 2006. Title: Probing the Microbiology of Deeply Buried Marine Sediments.

University of California, Los Angeles. Fall 2006. Title: Margins, Methane, and Microbes.

Goddard Space Flight Center, Spring 2005. Title: Terrestrial analogs 3 - biogenic methane.

NAI General Meeting (Boulder, CO), Spring 2005. Title: Geologic Primer, part 2.

Goldschmidt Conference (Copenhagen, Denmark), Summer 2004. Title: Using genomes to speculate on early microbial evolution & environments.

ASM Meeting (Salt Lake City, Utah), Spring 2002. Title: Single cell isotope techniques and biogeochemistry.

American Geophysical Union (San Francisco, CA), Fall 2005. Title: Linking Taxonomy with Environmental Geochemistry: the Anaerobic Oxidation of Methane in Cold Seeps & deeply Buried Marine Sediments.

Harvard University. Fall 2004. Title: Anaerobic methanotrophs in the marine subsurface.

NASA Astrobiology Institute Director's Seminar. Fall 2004. Title: Anaerobic methanotrophs in the marine subsurface.

Rutgers University. Fall 2004. Title: Anaerobic methanotrophs in the marine subsurface.

NAI Meeting (Tempe, AZ), Spring 2003. Title: Genomic-based tree building applied to 55 ecological Bacteria, Archaea, and Eukarya.

University of Maryland, Center for Environmental Science / Chesapeake Biological Laboratory. Fall 2003. Title: The carbon isotopic analysis of microbial cells: Investigations into the anaerobic oxidation of methane.

Gordon Research Conference on the Origin of Life, Summer 2003. Title: What do gene sequences say about the antiquity of life?

ASM Meeting (Washington, D.C.), Spring 2003. Title: Gene content based phylogenetic methods. *American Society of Microbiology Annual Meeting*. Washington, D.C. Rensselaer Polytechnic Institute. New York Center for Studies on the Origin of Life. Fall 2003.

Title: Tracing the Microbial Tree of Life: Novel Approaches Using Geochemistry and Genomics.

ISSOL Meeting (Oaxaca, Mexico), Summer 2002. Title: Exploration of subsurface Pacific microbial ecosystems.

University of California, Santa Cruz. Department of Molecular Biology. Fall 2002. Title: The Carbon Isotopic Analysis of Individual Modern or Fossil Cells, a Geochemical Approach to Studying Biochemistry.

Penn State University. Department of Geosciences. Fall 2002. Title: The Carbon Isotopic Analysis of Individual Modern or Fossil Cells, a Geochemical Approach to Studying Biochemistry.

AGU Meeting (San Francisco, CA), Fall 2002. Title: Microbial tungsten extraction from basalt under hydrothermal conditions (100°C).

University of North Carolina at Chapel Hill. Department of Marine Sciences. Fall 2002. Title: The Carbon Isotopic Analysis of Individual Modern or Fossil Cells, a Geochemical Approach to Studying Biochemistry.

Ohio State University. Department of Geological Sciences Lunch Brownbag. Spring 2002. Title: Of microbes and men (people): Whole genome-based phylogenetics applied to Bacteria, Archaea, and Eukarya.

Ohio State University. Department of Geological Sciences Colloquium Series. Spring 2002. Title: The Carbon Isotopic Analysis of Individual Modern or Fossil Cells, a Geochemical Approach to Studying Biochemistry.

Goldschmidt Meeting (Hot Springs, VA), Summer 2001. Title: Using homolog groups to create a whole-genome tree of free-living organisms: an update.

Woods Hole Oceanographic Institute. Fall 2001. Title: Of microbes and men (people): Whole genome-based phylogenetics applied to Bacteria, Archaea, and Eukarya. Monterey Bay Aquarium Research Institute Colloquium Series. Fall 2001. Title: Novel approaches for microbial geochemistry and for microbial phylogenetics.

University of Massachusetts, Lowell. Department of Biology Colloquium Series. Spring 2001. Title: Novel approaches for microbial phylogenetics and for microbial geochemistry.

State University of New York at Stony Brook Department of Geosciences Colloquium

Series.

Spring 2001. Title: Culture-independent study of carbon metabolism in microorganisms from the environment and from the fossil record.

Gordon Research Conference (Plymouth State College, NH), Summer 2000. Title: From Genomes to Microfossils: The search for ancient biochemical diversity.

University of Rochester, Department of Earth and Environmental Science Colloquium Series. Fall 2000. Title: Examining Microbial Diversity in the Precambrian.

University of Maryland, Department of Geology Colloquium Series. Fall 2000. Title: Examining Microbial Diversity in the Precambrian.

EUG Meeting (Strasbourg, France), Spring 1999. Title: Carbon isotopic analyses of Precambrian microfossils: a tool for constraining molecular evolution.

Arizona State University, Geology Colloquium Series. Fall 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

Carnegie Institute of Washington Seminar Series. Fall 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

University of Chicago, Department of Geophysical Sciences Colloquium Series. Fall 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

University of California, Los Angeles, Institute of Geophysics and Planetary Physics Astrobiology Seminar Series. Spring 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

Washington University in St. Louis, Department of Earth and Planetary Sciences Colloquium Series. Spring 1999. Title: From Genomes to Microfossils: The Search for Ancient Biochemical Diversity.

Caltech, Geology Club Seminar. Spring, 1997. Title: Pseudofossils and microfossils - important differences.